TECHNICAL MEMORANDUM NO. 1

February 10, 2016

To	Town of Eastham		
Copy to	Jane Crowley		
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Subject	Eastham Wastewater Management Plan Update to Wastewater and Nitrogen Management Needs Assessment	Job No.	8618665

1. INTRODUCTION AND SCOPE

The purpose of this Technical Memorandum No. 1 is to provide an update to the March 2009 Interim Needs Assessment with respect to the third recommendation of the wastewater plan which was focused on the environmental health need of the Nauset-Town Cove Estuary and Rock Harbor Estuary. This Needs Assessment update will guide the update to the alternatives analysis (to be summarized in Technical Memorandum No. 2) and the Town decision-making to develop a revised/updated wastewater management plan.

This memo is focused on wastewater planning which was put on hold with the intent of waiting until the nitrogen limits were established through a TMDL by MassDEP and until Orleans completed its wastewater planning process. Both of those actions are either underway or completed and the County's Regional 208 Plan is final. The Town is in a position to re-initiate the third task of the wastewater nitrogen management planning process. However, the means of addressing the nitrogen load to Nauset Harbor, Town Cove, Salt Pond and Rock Harbor will likely change as a result of: Orleans' recent planning efforts, updates to the areas of need based on new nitrogen loading information developed as part of the MEP program and the additional tools the 208 Plan is promoting.

A new wrinkle is the CCCs development of a TWMP approach to planning. This allows communities to focus in on particular watersheds outside of completing a full community-wide CWMP. It is envisioned that Targeted Watershed Management Plans (TWMP) will need to be developed in the future for Salt Pond, Town Cove, and Rock Harbor in accordance with the new regulatory review process recommended by the 208 Plan. Development of these TWMPs may be several years in the future. In addition, watershed reports must be completed by June 2016 that may include traditional and non-traditional scenarios.

The Town of Eastham has been developing a Wastewater Management Plan since 2007 and completed their Interim Needs Assessment and Alternatives Screening Analysis Report in March 2009 and their Wastewater Management Planning Project Plan Evaluation Report in June 2009. In summary, the Town's wastewater plan in 2009 focused on the Nauset Harbor/Town Cove estuaries and Rock Harbor and included the following components:

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1. Development of a public water supply system that draws water from a protected source to address septic-system wastewater impacts on individual private water supplies.
2. Development of a Ponds Action Plan and remediation of the Town's freshwater ponds that are most impacted from eutrophication (excessive algal growth) caused by excessive phosphorus loading to the freshwater ponds from several sources including wastewater.
3. Development of a wastewater collection system to collect wastewater from the Nauset-Town Cove Estuary, and Rock Harbor watersheds for treatment and discharge at the Tri-Town Septage Treatment Plant site in association with the Orleans wastewater management plan.

This planning effort was completed before the nitrogen limits were fully developed for the marine estuaries of Nauset Harbor/Town Cove Rock Harbor and the Town's other coastal embayments.

The first two components have been initiated and implementation is in progress as follows:

- The Town's municipal Town-wide water system construction is currently underway.
- The Town has also performed pond treatments (with alum) at Herring Pond and Great Pond.

2. BACKGROUND

2.1. Previous Findings of Eastham's Wastewater Planning Project Related to Coastal Estuaries and Nitrogen Mitigation

As discussed in the introduction, Eastham completed an Interim Needs Assessment based on information available up to 2009. The main findings of that Needs Assessment with respect to estuaries are summarized below:

- The Massachusetts Estuaries Project (MEP) had (at that time) initiated evaluations for the Nauset and Rock Harbor Estuaries to identify the ecological health of the estuaries and identify appropriate nitrogen limits.
- In June 2007, the MEP released the Draft Findings (Technical Report) for Rock Harbor with watershed delineations and the estimate that approximately 79% of the existing wastewater nitrogen loading to the watershed would need to be mitigated to restore the ecological health. Questions were raised on the water quality standard that was used to evaluate Rock Harbor. The report was finalized in December 2008. No nitrogen TMDL had been developed for this estuary as of 2009 (nor has one been produced by June 2015).
- As of 2009, the MEP had not identified estuary delineations or nitrogen limits for Nauset. Due to Eastham's desire to move the wastewater plan forward based on the best information available, the following assumptions were applied:
  - Watershed delineations developed by the Cape Cod Commission were used.
  - An estimate that 55% of the existing wastewater nitrogen loading to the entire watershed would need to be mitigated to restore the ecological health, as estimated by the Town of Orleans in their wastewater planning evaluations.

- The MEP had not yet initiated similar evaluations for Wellfleet Harbor, Boat Meadow, or Herring River; therefore no nitrogen removal assumptions were made for the small portion of the Wellfleet Harbor watershed or for Boat Meadow or Herring River. As part of the Cape Cod Commission 208 planning efforts, nitrogen loading information has been compiled, including the percentage that is estimated to originate from Eastham; however the removal thresholds for these sub-embayments have not been set and are awaiting the completion of the MEP efforts.

Figure 1 illustrates the watersheds and nitrogen removal limits as reported in the 2009 Needs Assessment.

Appendix A contains the summary newsletter of the previous wastewater planning efforts as well as a CD of the previous planning documents.

2.2. MEP and Third Party Evaluations for the Nauset Estuary Since 2009

MEP evaluations for Nauset Estuary were completed and are summarized in a draft technical report dated May 2012. The Town of Orleans commissioned a third party technical review of the MEP report by RPS-ASA of South Kingstown, Rhode Island dated November 2012. The third party technical review was followed by a Technical Memorandum from MEP dated December 4, 2012 which was then followed by an Addendum to the third party technical review dated December 24, 2012. The MEP has not yet released a final technical report for Nauset Estuary, and a TMDL has not yet been developed.

Figure 1 shows the 2009 watershed boundaries with removal percentages and Figure 2 shows the updated watershed boundaries with removal percentages. Figures 3 and 4 show the change in the watershed delineations and the refinement of target areas of removal. As shown in Figure 2, the extent of the watershed to Town Cove is extended northward to include Mary Chase Gauge and Nauset Stream. The remaining focus of the Nauset Marsh estuary examined in 2009 is now targeted around Ministers Pond and Salt Pond watersheds. Because only a small percentage (less than 2% of the total nitrogen load) of Depot Pond contributes to Salt Pond, this portion is not currently included in the watershed area being targeted for 100%. The attenuation factors and loads are shown in Table IV-2, "Nauset Estuary Watershed Nitrogen Loads" from the MEP Nauset Harbor Embayment System Report, Revised Draft Report, May 2012.

2.2.1. Nauset Marsh Estuary Contributory Areas and Delineation

As discussed in Section III.3 of the MEP Draft Report for Nauset Harbor Embayment System, the refined watershed and sub-watershed boundaries for the Nauset Marsh embayment system, including Town Cove, Salt Pond, and Ministers Pond and other sub-estuaries were determined by the USGS. Model outputs of watershed boundaries were "smoothed" to further define the subembayments. The smoothing refinement was a collaborative effort between the USGS and the rest of the MEP Technical Team. Overall, 13 sub-watershed areas plus a portion of the flow from Bakers Pond were delineated within the Nauset Estuary study area.[1]

The MEP watershed delineation for the Nauset Marsh system as a whole is roughly the same as the one developed by the CCC in 1998 (6,361 acres vs. 6,425 acres, respectively). The delineations are slightly

[1] Howes B., S. Kelley, J.S. Ramsey, E. Eichner, R. Samimy, D. Schlezinger, P. Detjens (2011). Massachusetts Estuaries Project Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Thresholds for the Nauset Harbor Embayment System, Towns of Orleans and Eastham, Massachusetts, Massachusetts Department of Environmental Protection. Boston, MA.[2] Orleans CWMP/SEIR, Executive Summary page ES-4.

different, largely due to the internal sub-watershed refinements identified in the MEP reports and the change in location of the regional groundwater divide in the Nauset Lens. The MEP watershed delineation also includes interior sub-watersheds to various components of the Nauset Marsh system, such as ponds that were not fully included in the CCC delineation, as well as sub-watersheds to the stream gauged during the MEP: near Mary Chase Road. These refinements are considered a benefit of the update of the USGS regional groundwater models.[1]

Table 1 shows the updated estimated percentage of septic system nitrogen to be removed from these targeted watersheds.

Table 1 MEP Table VIII-2 from the May 2012 Revised Draft Report for Nauset Harbor Embayment System

Comparison of Sub-embayment Watershed Septic Loads (attenuated)			
Sub-embayment	Present septic load (kg/d)	Threshold septic load (kg/d)	Threshold septic load % change
Salt Pond/Ministers	4.15	0.00	-100%
Town Cove	24.27	6.07	-75%
Nauset Stream / Mary Chase Gauge	1.90	0.47	-75%

As shown in Table 1, the estimated percent nitrogen removal from septic systems in these areas has changed from the assumed 55% across the entire Nauset System to 100% in the Salt Pond/Ministers Pond watersheds and 75% in the Town Cove/Nauset Stream/Mary Chase Gauge watersheds.

2.3. Town of Orleans CWMP Project

The Town of Orleans CWMP was initially completed in December 2010 with the submission of their Comprehensive Wastewater Management Plan and Single Environmental Impact Report (CWMP/SEIR) by Wright-Pierce. This plan was reviewed under and approved by the Massachusetts Environmental Protection Act (MEPA) as summarized in the January 28, 2011 MEPA Certificate, and approved by the Cape Cod Commission (CCC) in their October 31, 2011 Development of Regional Impact (DRI) decision. These three documents are located on the Town of Orleans Web site at http://www.town.orleans.ma.us/water-quality-advisory-panel/pages/cwmpwastewater-archives.

The Orleans CWMP/SEIR provides discussion on the opportunity for regionalization of wastewater management with Eastham and Brewster after the first three phases of the Orleans core program[2].

There have been several additional planning efforts to identify additional and/or different wastewater and nutrient management approaches in Orleans as identified on the Town's Web site. The most recent effort was a series of evaluations using the 208 planning methods developed by the Cape Cod Commission.

[2] Orleans CWMP/SEIR, Executive Summary page ES-4.

These evaluations and the resulting Town decision-making process resulted in a group of agreed upon goals, objectives, plan approaches, and commitments that are summarized in a March 2015 Consensus Statement (attached in Appendix B). In addition, a *Conceptual Approach to Meet Orleans Water Quality Goals* (attached in Appendix B) developed by Stantec estimates technologies and sizes within each watershed that could reasonably be implemented to help meet TMDLs and water quality needs. This document and conceptual map prepared for that project identify the next steps and proposed approaches for Orleans.

2.4. Cape Cod Commission 208 Planning

The Cape Cod Commission has finalized their Cape Cod Area Wide Water Quality Management Plan Update (208 Plan) and it has been approved by USEPA. This document identifies many nitrogen management and planning components that can be used as part of a municipal wastewater planning process, such as Eastham's, including:

- Identification of Waste Management Agencies (WMA) that will work to share responsibility to meet the nitrogen TMDLs for coastal estuaries.
- Development of Watershed Reports for each watershed wholly or partially within Town boundaries.
- Expanded innovative and alternative nitrogen management approaches and technologies.
- New wastewater management evaluation tools to estimate existing and future wastewater flows and nitrogen loading as well as alternative wastewater nitrogen management scenarios.
- The requirement to complete a Targeted Watershed Management Plan (TWMP) for estuaries and their watersheds that exceed established nitrogen TMDLs.
- Revised regulatory procedures to streamline the review process when TWMP is properly completed.
- Recommendations to MassDEP to develop a watershed permitting program to allow nitrogen removal credits for traditional as well as non-traditional management techniques to meet a nitrogen TMDL.
- County support to develop individual TWMPs.

The next steps of Eastham's wastewater management planning project will utilize many of these components.

New wastewater management evaluation tools developed by the Cape Cod Commission include what is commonly referred to in this technical memorandum as "WatershedMVP" which is an abbreviated name for Watershed Multi-Variant Planner. This is an online tool where existing and future water and wastewater flows and loads can be extracted based on Town, watershed or sub-watershed lines or by polygons drawn by the user. The WatershedMVP tool was used during the development of this Technical Memorandum when examining estimated wastewater flows and nitrogen loads within the watershed of interest.

2.5. Additional Town and Related Regional Projects

There are other town wastewater planning projects on Cape Cod that can provide information, experience, and cost estimates for Eastham's planning process; and that information will be used as alternative technologies are evaluated.

For example, USEPA released a solicitation in June 2015 requesting a Statement of Interest from Cape Cod Towns with south facing embayments who would be interested in hydrogeological site characterizations for the design of Permeable Reactive Barriers (PRBs). Although Eastham was not one of the municipalities listed with an eligible watershed under the Southeast New England Program (SNEP), the Town submitted a statement of interest with support from the Cape Cod National Seashore (CCNS) for possible PRB site characterization at the CCNS's Salt Pond Visitor Center. One of the requirements of the opportunity was willingness to show other municipalities the site and data for the duration of the project and beyond, should a pilot PRB be constructed at the site. This type of data sharing for non-traditional technologies will have a regional benefit to Towns including Eastham as they move forward in their planning.

There are several grant funding opportunities that should be developed as the Eastham project proceeds to support planning. One grant that was received by the Town was a $30,000 MassDEP grant for Water Infrastructure Planning and Technical Assistance which supports this current effort to update the Town's wastewater management planning project.

The Town is working with EcoLogic to review data files of existing water quality data collected within the estuarine areas. A summary of those findings has been drafted in a Technical Memorandum entitled, "Overview and Implications of the Nauset Harbor Estuary TMDL." In general, the technical memorandum shows how water quality is clearly in decline. The goal of these data review efforts is to show the relation of current and historic water quality data to the data as presented in the existing MEP reports. The scope of this work includes:

Examination of the trophic status of the estuarine waters; that is, the levels of nutrients, phytoplankton pigments, and dissolved oxygen and water clarity conditions in these areas. The technical review and discussion includes:

- Current water quality status with respect to MEP guidelines and TMDL target levels (as relevant).
- Trends in water quality indicators over time.
- Review of findings with Town staff, boards, and interested residents.

A similar review will be conducted for Rock Harbor.

3. EXISTING AND PROPOSED LAND USE IN PROJECT FLOW AREAS

The main project focus area for Eastham at this time is Salt Pond, Town Cove, and Rock Harbor. However, the Town is starting with Salt Pond and Town Cove because both Orleans and Eastham are continuing to coordinate discussions for the reclassification of Rock Harbor from an estuary to a man-made boat basin and because there are no MEP reports developed for the other watersheds in Town.

Figure 1 shows the project focus area which includes Salt Pond and Town Cove which are both located in the Nauset Estuarine System. Salt Pond (including the watershed for Minsters Pond) is entirely within Town

limits and requires 100% removal of existing wastewater nitrogen to the watershed to restore the ecological health. Town Cove is shared with Orleans and requires 75% removal of existing wastewater nitrogen to the watershed to restore ecological health. The Town Cove watershed includes the sub-watersheds for Mary Chase Gauge and Nauset Stream which are completely within the Town boundaries of Eastham.

3.1. Water Use Comparison

The following assumptions and background information are provided for comparison of the various planning efforts and reports; the 2009 planning, MEP reports and the CCC 208 Plan for single family residential water and wastewater flows. The water use data in the CCC 208 Planning Tool has been developed outside of the MEP efforts and is based on available water usage data (2009 to 2011 was cited as the typical years of water data available across communities throughout Cape Cod, but in some cases newer data is available). Since the Town of Eastham does not currently have a public water system in operation, water usage in the CCC 208 Planning tool was estimated based on average values across all of Cape Cod. All previous evaluations for estimating water use, with the exception of the Eastham Water System, assume 90% of total water flow is wastewater flow. The evaluation completed to support the Eastham Water System was developed by using per capita flow estimates for residential and by back calculating a water use from Title 5 wastewater flow estimates for commercial use.

It is our opinion that the CCC 208 Planning Tool assumptions appear to be an overestimate when using a Cape-wide average. Additional data has been requested from the CCC on the values used in Orleans within shared watersheds so that a comparison of residential use within Town Cove and Rock Harbor on the Orleans side (based on actual water use) can be made. This would eliminate assumptions carried across varying demographics on Cape Cod, and should be more representative of water use in Eastham.

Table 2 Assumptions of Planning Efforts to Date for Water and Wastewater Flows in Eastham

Assumption	2009 Planning[1]	MEP Report	CCC 208 Plan	Eastham Water System	Proposed Assumptions[2]
Single Family Residential Water Flow	142 gpd	142 gpd – Rock Harbor 148 gpd – Nauset Estuary	181.51	136 gpd	136 gpd
Single Family Residential Wastewater Flow	90% of Water Flow = 128 gpd	128 – Rock Harbor 134 – Nauset Estuary	90% of Water Flow = 163.36	122 gpd	122gpd

Notes:

(1) The existing average annual wastewater flow estimates are based on the work and methodology of the MEP for the Rock Harbor estuary.

(2) Proposed assumptions are based on the detailed water demand projection used for the development of the Town's water system. For Residential/Commercial Class 130; water demand is based on average of 2.08 residents/household and 3.1 bedrooms/household. Water demand (i = 65 residential gallons per capita day (rgpcd)). Single family residential wastewater flow is estimated at 90% of water flow.

This is based on the following:

- The updated CCC 208 assumptions result in estimated wastewater flows that are about 28% larger than assumed in 2009 Eastham planning.
- When examining the estimated wastewater flows used as part of the MEP reports, the MEP values are closer to those used in 2009 Eastham planning. This flow information formed the basis of their nitrogen loading values, which the CCC 208 Plan bases their reduction requirement on as outlined in Appendix 8C of the 208 Plan.
- In addition, as part of the detailed water demand projections used for the development of the Town's water system, average water consumption was estimated at 136 gpd for residential properties based on 2.08 residents per household and 65 gallons of water use per residential capita per day.

3.2. Development and Landuse Comparison

Table 3 provides a parcel analysis by watershed and provides a comparison of the 2009 Eastham planning effort and updated watershed delineations provided by the MEP. This data was compiled using data extracted from CCCs 208 Planning Tool (MVP).

Table 3 Number of Parcels by Watershed in Eastham

Watershed	Sub-embayment	No. of Parcels – 2009 Eastham Planning Delineation[2]	No. of Parcels – CCC 208 Planning Tool	Change in Parcel Count (+/-)
Boat Meadow	Boat Meadow River	368	369	+1
Herring River (Eastham)	Herring River (Eastham)	427	414	-13
Rock Harbor	Rock Harbor	113	118	+5
Town Cove / Nauset Marsh[1]	Nauset Marsh	1,725	550	-160
	Nauset Stream/Mary Chase Gauge		288	
	Salt Pond		361	
	Town Cove		366	
Wellfleet Harbor	Wellfleet Harbor	668	517	-151
Total		**3,301**	**2,983**	**-318**

Notes:
(1) Total Number of Parcels in Town Cove / Nauset Marsh after summing for CCC 208 Watershed Tool column = 1,565.
(2) Parcel count based on existing developed and developable properties where water usage is expected to occur.

The changes, most significantly in Town Cove/Nauset Marsh and Wellfleet Harbor, represent the variation between the original CCC watershed boundaries and the revised/updated watershed delineations used in their 208 planning tools. This difference can be seen in Figures 3 and 4 with the two watersheds shown as an overlay comparison of the CCC delineation and the MEP watershed delineation for both Nauset Harbor Watershed (Figure 3) and the remaining Eastham watersheds (Wellfleet Harbor, Herring River, Boat Meadow and Rock Harbor). It was necessary to present the Nauset Harbor watershed separate from the other neighboring watersheds to effectively show increases and decreases in area. In locations where Nauset Harbor may have gained area/parcels by a shift in watershed delineation, Herring Pond for example may have lost area/parcels. As previously discussed in Section 2.2.1, the watershed delineations developed by the CCC changed based on model refinements and additional data from the USGS as part of the MEP Project.

Table 4 presents a breakdown of the landuse within these new watershed boundary areas in Eastham based on the data compiled as part of the 208 planning tool.

Table 4 Land Use by Sub-embayment in Eastham using CCC's 208 Planning Tool [(1)]

Watershed	Sub-embayments	% Residential	% Commercial	% Industrial	% Multi-Family Residential	% Other Development	% Residential Condo/Apt	% Vacant Non-Development
Boat Meadow	Boat Meadow River	93	1.5	-	4.5	1	-	-
Herring River (Eastham)	Herring River (Eastham)	97	-	-	2.25	0.5	0.25	-
Rock Harbor	Rock Harbor	86	-	-	8	3	1	2
Town Cove/Nauset Marsh	Nauset Marsh	76	10.5	7.25	5	0.25	1	-
	Nauset Stream[(2)]	92	-	-	6.5	0.5	1	-
	Salt Pond	71	10.75	8.25	7	1	2	-
	Town Cove	81	7.5	-	8	1.5	1.5	-
Wellfleet Harbor	Wellfleet Harbor	83	10	-	5.5	0.75	0.75	-

Note:
(1) Percentages rounded to nearest 0.25%
(2) Includes Mary Chase Gauge

As clearly shown in Table 4, the majority of each of these watersheds is residential; therefore the residential water assumptions (discussed in Section 3.1) can have a significant impact on nitrogen management strategies and the projection of nitrogen load generated in each watershed.

3.3 Nitrogen Loading Discussion

Table 5 presents a summary of existing wastewater flows and loads in Eastham; from the 2009 planning efforts to the updated CCC 208 planning efforts. The CCC 208 Planning Tool Wastewater Flow is extracted from the CCC's WatershedMVP tool. The unattenuated nitrogen loading calculation is presented in Appendix 8C: Sub-embayment Watersheds in the 208 Plan. For example, Rock Harbor is identified by the 208 Plan as having an unattenuated load of 2,558 kg. Eastham is identified as having a 21% responsibility; this is percent of controllable attenuated load that a town contributes to the watershed. By multiplying 2,558 kg x 21% the unattenuated nitrogen loading for Eastham is estimated. The reduction target and percent responsibilities are presented from the 208 Plan's Appendix 8C. The reduction target is multiplied by the percent responsibility to attain Eastham's estimated kilogram responsibility number as presented in the 208 Plan Appendix.

(continued on next page)

Table 5 Summary of Estimated Existing Wastewater Flows and Loads in Eastham

Major Watershed Areas [1]	2009 Eastham Planning Efforts		Updated CCC 208 Planning Efforts	
	Average Annual Wastewater Flow (mgd) [2][3][4]	Unattenuated Nitrogen Loading (kg/yr) [3][4]	CCC 208 Planning Tool Wastewater Flow (mgd) [5][7]	Unattenuated Nitrogen Loading (kg/yr) [6][7]
Rock Harbor Estuary	0.01	390	0.02	540
Nauset-Town Cove Estuary	0.22	7,900	0.24	11,400
Wellfleet Harbor	0.09	3,200	0.09	3,600
Herring River	0.05	1,700	0.06	2,600
Boat Meadow River	0.04	1,600	0.05	2,300
Atlantic Ocean Recharge Area	0.09	3,300	N/A	N/A
Cape Cod Bay Recharge Area	0.32	11,700	N/A	N/A
Total	**0.82**	**29,800**	**0.49**	**20,440**

Notes:

(1) Delineations for 2009 report were based on the work of the Cape Cod Commission and USGS with the exception of Rock Harbor Estuary which was delineated by the MEP.

(2) The existing average annual wastewater flow estimates are based on the work and methodology of the MEP for the Rock Harbor estuary.

(3) The wastewater nitrogen loading to the groundwater system associated with these existing flows were developed by MEP based on an average nitrogen concentration of 26.25 mg/L.

(4) Data shown is from Table 4-2 of the Final Interim Needs Assessment & Alternatives Screening Analysis Report.

(5) Based on the Cape Cod Commission value of 181.5 gpd in Table 2.

(6) Nitrogen loading is calculated by multiplying the unattenuated load value by the percent responsibility from the Eastham, Sub-embayment Watersheds located in Appendix 8C of the Cape Cod Area Wide Water Quality Management Plan Update.

(7) "N/A" = "Not Available" and is used when no information is available.

Table 5 provides a comparison of existing average annual wastewater flow from the 2009 Eastham planning effort to the CCC updated planning effort. The flow estimates developed for 2009 were based on the methodology of the MEP for their work on Rock Harbor estuary (referenced in Table 2 above). Flow estimates developed from the 208 planning process include a higher residential flow based on a Cape-wide average of 181.5 gpd as Eastham currently does not have Town water data. The cape-wide average flow of 181.5 gpd that is applied to Eastham is much higher than the 142 gpd applied by the MEP for Rock Harbor (and subsequently 148 gpd for Nauset Estuary) as identified in Table 2. This higher value will contribute to the differences in estimated wastewater flows and nitrogen loads associated with wastewater.

Figure 5 shows the MEP estimated percent removal required of controllable wastewater nitrogen and the percent responsibility of Eastham (Orleans and Brewster) for Salt Pond, Nauset Stream (including Mary

Chase Gauge), Town Cove and Rock Harbor based on the updated 208 Plan information. These estimated removals are summarized as follows:

- **Salt Pond** has an estimated 100% MEP removal percentage and Eastham has 100% of the responsibility of the controllable attenuated load to Salt Pond.
- **Nauset Stream** has an estimated 75% MEP nitrogen removal and Eastham contributes 100% of the controllable attenuated load.
- **Town Cove** being a shared watershed is more complex in that it has an estimated 75% MEP removal percentage but only 25% of the controllable attenuated load is what Eastham contributes, Orleans contributes 74% and Brewster contributes 1%.
- **Rock Harbor** is also a shared watershed and has a 78.8% MEP removal percentage and 21% of the controllable attenuated load is what Eastham contributes, Orleans contributes 79%.

However, the percent contributions are impacted by the method of calculating the nitrogen load to the waterbody. If the CCC 208 Plan method of estimating wastewater flow in Eastham is overly conservative, this results in an over estimate of nitrogen removal required. The following is presented as an example of this in the Salt Pond watershed.

The following table shows the estimated difference between the 208 Plan estimates and those developed by MEP in 2012.

Table 6 Salt Pond Nitrogen Loading Summary

Sub-embayment: Salt Pond	Unattenuated Load (kg)	Attenuated Load (kg)	MEP Threshold (kg)	Reduction target (attenuated – threshold) (kg)
208 Plan	2,930	1,990	434	1,556
MEP	2,330	1,700	434	1,266

Notes:
(1) 208 plan assumes 164 gpd per single family residential parcel
(2) MEP plan assumes 134 gpd per single family residential parcel

To further demonstrate this point if estimating unattenuated nitrogen load based on estimated number of residential parcels and converting that to an estimated nitrogen load, Table 7 summarizes this approach for Salt Pond.

Table 7 Salt Pond Single Family Residential Loading Estimates

Sub-embayment: Salt Pond	Estimated Single Family Residential Flow (gpd)	Estimated Unattenuated Residential Load (kg/yr)
208 Plan	42,000	1,530
Eastham 2015 Water (1)	31,400	1,140
Difference	10,600	390

Note:

(1) Flow estimates based on 122 gpd x estimated number of residential parcels. The estimated number of residential parcels is calculated from using the data for no. of parcels is Table 3 and multiplying it by the % residential in Table 4 for Salt Pond.

As shown in Tables 6 and 7, Eastham could be expected to remove 25% more nitrogen based on CCC 208 Plan higher water value.

Detailed evaluations and sensitivity analysis of flow data will be a part of the hybrid evaluations identified for Technical Memoranda Nos. 3 and 4 following receipt of additional water data from the Cape Cod Commission.

4. ESTIMATED NITROGEN LIMITS FOR TOWN COVE, SALT POND, AND ROCK HARBOR

The following discussion summarizes the current information presented in the 208 Plan and their estimates of nitrogen load and responsibility as previously discussed. Using their planning tool, flows and load estimates were aggregated. However, because of the significant difference in single family residential wastewater generation rate estimates, Eastham will consider a phased approach to managing their load. As part of this evaluation, it is proposed that Eastham will work towards wastewater nitrogen load management based on the 122 gpd estimated wastewater flow. However, through phasing and following the long-term modeling and monitoring, Eastham will consider the higher CCC 208 Planning numbers as an upper limit if nitrogen loading reductions do not achieve these levels based on the 122 gpd planning number. It is expected that the Adaptive Management Approach that will be developed and adopted by Eastham will address this as Eastham works to complete its planning efforts.

Tables 8 and 9 show the estimated existing wastewater flows and estimated future wastewater flows for each sub-watershed/sub-embayment area as part of the Project Focus Area. Flows and loadings are based on two different flow assumptions and will be considered as part of the Town's Adaptive Management approach in considering load removals to achieve future TMDL compliance.

Table 8 Estimated Existing Wastewater Flows

Sub-watershed	Estimated # of Parcels[6]	Eastham 2015 Est. [1][4]		CCC 208 Est.[4]	
		Estimated Existing Flows (gpd)	Estimated Existing Load (kg/y)	Estimated Existing Flows (gpd)	Estimated Existing Load (kg/y)
Town Cove Total	654	75,100	2,450	98,400	3,100
Town Cove	*366*	*45,800*	*1,700*	*58,100*	*2,110*
Mary Chase Gauge	*262*	*26,600*	*650*	*36,500*	*860*
Nauset Stream	*26*	*2,700*	*100*	*3,800*	*140*
Salt Pond Total[2][3]	361	60,600	1,350	70,800	1,580
Salt Pond	*247*	*26,900*	*1,000*	*35,400*	*1,280*
Ministers Pond[5]	*114*	*33,700*	*350*	*35,400*	*300*
Rock Harbor	118	8,000	300	12,200	440

Notes:

(1) Eastham estimates calculated based residential properties within watershed at 122 gpd per property vs the 208 Plan estimates of 163.36 gpd residential properties. All non-single family residential flows were assumed to be the same between each method.

(2) These values include both Eastham and the Cape Cod National Seashore.

(3) Less than 2% of the load from Depot Pond contributes to Salt Pond's load, therefore this sub-embayment was not included in this analysis but may be looked at during the hybrid evaluations.

(4) Attenuation (flow through %): Mary Chase Gauge (65%), Ministers Pond (29%)

(5) Need to review Ministers Pond loading with Cape Cod Commission to identify the additional removal represented in their values.

(6) As quantified in the CCC 208 Planning Tool "MVP."

(continued on next page)

Table 9 Estimated Future Wastewater Flows

Sub-watershed	Eastham 2015 Est.[1][5]		CCC 208 Est.[5]	
	Estimated Future Flows (gpd)	Estimated Future Load (kg/y)	Estimated Future Flows (gpd)	Estimated Future Load (kg/y)
Town Cove Total	91,500	2,900	114,800	3,630
Town Cove	*57,000*	*2,100*	*69,300*	*2,510*
Mary Chase Gauge	*31,600*	*720*	*41,500*	*980*
Nauset Stream	*2,900*	*100*	*4,000*	*140*
Salt Pond Total[2][3]	91,200	1,700	101,400	1,860
Salt Pond	*30,800*	*1,100*	*39,300*	*1,280*
Ministers Pond	*60,400*	*600*	*62,100*[4]	*580*
Rock Harbor	12,300	400	16,500	600

Notes:

1) Eastham estimates calculated based on residential properties within watershed at 122 gpd per property vs the 208 Plan estimates of 163.36 gpd residential properties. All non-single family residential flows were assumed to be the same between each method.
(2) These values include both Eastham and the Cape Cod National Seashore.
(3) Less than 2% of the load from Depot Pond contributes to Salt Pond's load, therefore this sub-embayment was not included in this analysis but may be looked at during the hybrid evaluations.
(4) The CCC 208 planning tool has identified large vacant developable properties with large flows assigned to the future.
(5) Attenuation (flow through %): Mary Chase Gauge (65%), Ministers Pond (29%)
(6) Need to review Ministers Pond loading with Cape Cod Commission to identify the additional removal represented in their values.

The impact of the higher water use will be considered in the sensitivity analysis that will need to be performed as part of the hybrid evaluations of Salt Pond and Town Cove, depending on the amount of non-traditional solutions considered within those watersheds depending on effectiveness of these approaches. As shown in Tables 8 and 9, the lower estimates are based on a lower single family residential flow as outlined in Table 2.

The Cape Cod Commission then developed their nitrogen loadings from these updated estimates and compared them to the MEP removal requirements (under their approach of addressing septic system loading). This data was then compiled on a sub-watershed basis and the contribution of each town was considered as part of their 208 Planning efforts. The same was then done by GHD for the Eastham flow estimates based on 122 gpd.

Appendix 8C in the 208 Plan Update provides a chart for sub-embayment watersheds and nitrogen responsibility by Town. The information below is extracted from that Cape Cod area wide visual and provides information on the sub-embayments of Wellfleet Harbor, Rock Harbor, Nauset, Boat Meadow and Herring River (Eastham) along with the percent contribution of each Town in that sub-embayment. For example, Eastham has 21% of the responsibility for Rock Harbor and Orleans has 79% of the responsibility. This

allocation (percent contribution) places a value on the nitrogen removal required in kilograms for each Town for each sub-embayment.

Wellfleet Harbor:

- Eastham = 11%
- Wellfleet = 88%
- Truro = 2%

Rock Harbor:

- Orleans = 79% & 100% Cedar Pond
- Eastham = 21%

Nauset:

- Orleans = 100% Mill Pond, 23% Nauset Marsh, 100% Rachel Cove, 74% Town Cove and 100% Woods Cove
- Eastham = 77% Nauset Marsh, 100% Nauset Stream, 100% Salt Pond and 25% Town Cove
- Brewster = 1% Town Cove

Boat Meadow:

- Orleans = 4%
- Eastham = 96%

Herring River:

- Eastham = 100%

Table 10 presents the watersheds discussed in 2009 and compares the estimated nitrogen load removals with those estimated by the 208 Planning efforts. The Existing Estimated Removal percentage in 2009 represents what was used for estimating the amount of nitrogen to be removed based on the information available at that time. Since that document was released, a draft MEP report for Nauset Estuary was released adjusting the watershed delineations and percent removals. When considering those and the CCCs allocation of responsibility, revised daily kilogram loads of nitrogen to be removed are presented in the last column under the estimated worst case condition if 163.36 gpd of wastewater is generated for each single family residence.

Table 10 Summary of Existing Removal Quantities and Percentages

Watershed	Sub-embayment	2009 Eastham Planning Effort		Updated 208 Planning Effort		
		Estimate of Existing Removal Requirements (%) [1][5]	Estimated Nitrogen Load to be Treated (kg/d)[1][5]	Existing Estimated Removal (%) [2]	Eastham's Responsibility of Watershed (%) [3]	Kilogram Responsibility (kg/d) [4]
Boat Meadow	Boat Meadow River	N/A	N/A	N/A	96%	N/A
Herring River (Eastham)	Herring River (Eastham)	N/A	N/A	N/A	100%	N/A
Rock Harbor	Rock Harbor	79%	0.84	78.8%	21%	0.93
Town Cove / Nauset Marsh	Nauset Marsh	55%	11.90	0%	77%	13.5
	Nauset Stream			75%	100%	
	Salt Pond			100%	100%	
	Town Cove			75%	25%	
Wellfleet Harbor	Wellfleet Harbor	N/A	N/A	N/A	11%	N/A

Notes:

(1) Estimated percentage of septic system nitrogen removal based on MEP report dated December 2008 for Rock Harbor (Final) and the Town of Orleans in their wastewater planning evaluations for Nauset Harbor.

(2) Estimated percentage of septic system nitrogen removal based on MEP reports dated December 2008 for Rock Harbor (Final) and May 2012 for Nauset Harbor (Revised Draft).

(3) Estimated by CCC of the total watershed load from Eastham in Appendix 8C of the Cape Cod Area Wide Water Quality Management Plan Update

(4) Estimated kg responsibility of the reduction target (Target load x % of Watershed Responsibility) form Appendix 8C of the Cape Cod Area Wide Water Quality Management Plan Update divided by 365 days/year.

(5) Data shown is from Table 4-5 of the Final Interim Needs Assessment & Alternatives Screening Analysis Report.

Based on the increased percent removals in Nauset/Town Cove estuaries, an increased nitrogen removal has been estimated by the CCC.

Figure 5 provides a depiction of the MEP required percentage removal required of controllable wastewater nitrogen and how it compares with Eastham's percent responsibility of the watershed.

5. SUMMARY OF UPDATED NEEDS ASSESSMENT AND NEXT STEPS

Based on the updated information for Town Cove and Rock Harbor and information developed by the CCC as part of the 208 planning process, the following revised areas of concern surrounding the Town Cove/Nauset Stream/Mary Chase Gauge, and Salt Pond/Ministers Pond and Rock Harbor will be the focus of the next steps of the process. The following table summarizes the estimated nitrogen removal loads based on the wastewater flow estimates discussed in Tables 8 and 9. Flows are not presented because alternative

technologies are being considered in Technical Memorandum No. 2 and therefore the flows to be treated will be developed in the hybrid solution evaluations as part of Technical Memoranda Nos. 3 and 4.

Table 11 Project Focus Area Removals for Existing and Future Nitrogen Loads using a Phased Approach

Estimated MEP % Removal	Sub-watershed	Estimated Minimum Wastewater Load to Remove (kg/y)[2][3]	Estimated Maximum Wastewater Load to Remove (kg/y)[1][3]
75%	**Town Cove Total**	**1,840**	**2,720**
	Town Cove	*1,280*	*1,880*
	Mary Chase Gauge	*490*	*740*
	Nauset Stream	*80*	*110*
100%	**Salt Pond Total**	**1,350**	**1,860**
	Salt Pond	*1,000*	*1,280*
	Ministers Pond	*350*	*580*
78.8%	**Rock Harbor**	**240**	**470**

Notes:
(1) Removal % needed is based on existing loads; all future loads beyond the existing load will need to be removed 100%.
(2) Minimum loads based on Eastham wastewater generation rate assumption of 122 gpd.
(3) Minimum value based on Eastham estimated residential flows and maximum based on CCC 208 MVP Tool estimates.

As discussed above there is a difference between wastewater flow estimates and therefore Table 11 provides a range of nitrogen removals. The minimum is based on existing conditions at 122 gpd per single family residence and the estimated maximum is based on the CCC 208 Planning tool as presented in Table 9 under future conditions. The evaluations done in subsequent tasks will take this into consideration when developing hybrid solutions.

Next steps of this project:

- Further evaluation of water use data to determine if the cape-wide average applied might affect Eastham's contribution. The flow data will be analyzed as part of the hybrid evaluations for Salt Pond and Town Cove to be developed in GHD's Technical Memoranda Nos. 3 and 4.
- Discussions with Orleans regarding their proposed approaches for Rock Harbor and Town Cove and alternative regional solutions. In addition, confirm that no traditional infrastructure regional solutions are being considered by Orleans at this time.
- Town Review of Technical Memorandum No. 1 findings.
- Town Review of Technical Memorandum No. 2: The purpose of this Technical Memorandum is to provide an update to the Alternatives Screening Analysis in order to guide the Town decision-making

in developing a revised/updated wastewater management plan and take into consideration additional information developed as part of the Cape Cod Commission 208 Planning process. Technical Memorandum No. 2 will follow a similar format to this document, and will summarize the following:

- Reconsideration of Alternatives screened in March 2009 Final Interim (Needs Assessment) & Alternatives Screening Analysis Report and the recommendations made as part of the 2009 Plan Evaluation Report.
- Additional nitrogen management concepts developed in the CCC 208 Plan.
- Background (book-end evaluations developed in the 208 planning project)
- Summary of feasible alternatives and proposed evaluation process for the project focus area
- Outline of the process of evaluating hybrid solutions for Salt Pond and Town Cove

- Newsletter: This newsletter will be prepared to summarize the findings of Technical Memoranda Nos. 1 and 2. This newsletter will be similar to what was prepared for the 2009 Wastewater Management Planning Project (attached in Appendix A).
- Compile new public water use data for three consecutive years.

List of Acronyms

ACRONYMS

208 Plan = Cape Cod Commission's Cape Cod Area Wide Water Quality Management Plan Update

CCC = Cape Cod Commission

CWMP = Comprehensive Wastewater Management Plan

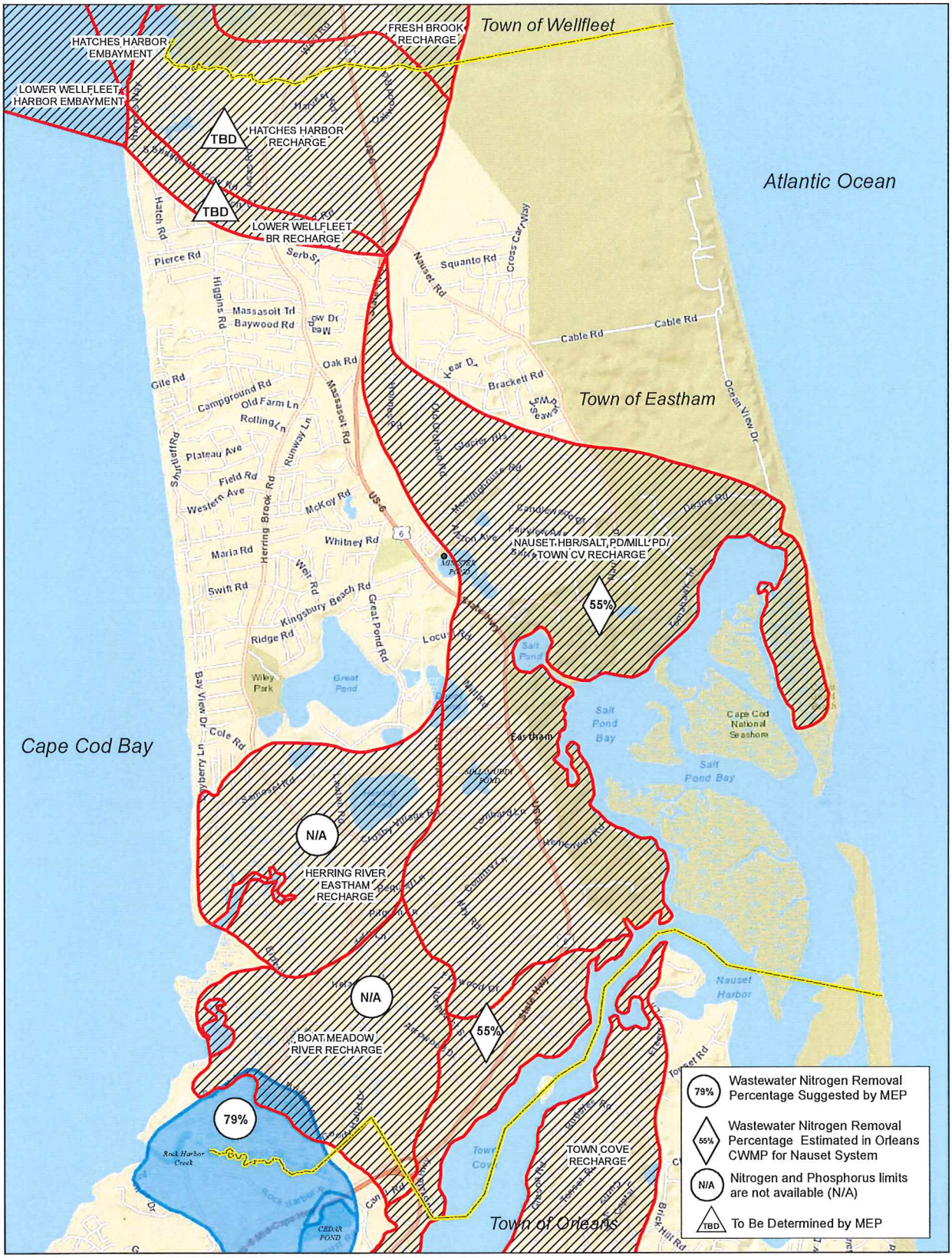
DRI = Development of Regional Impact (Cape Cod Commission)

MEP = Massachusetts Estuaries Project

MVP = Multi-Variant Planner (Watershed MVP); Cape Cod Commission's 208 Planning Tool

TWMP = Targeted Watershed Management Plan

Figures



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GHD

Town of Eastham, Massachusetts
Technical Memorandum #1

Job Number 86-18665
Revision A
Date 17 Dec 2015

2009 Watershed Boundaries with Removal Percentages

Figure 1

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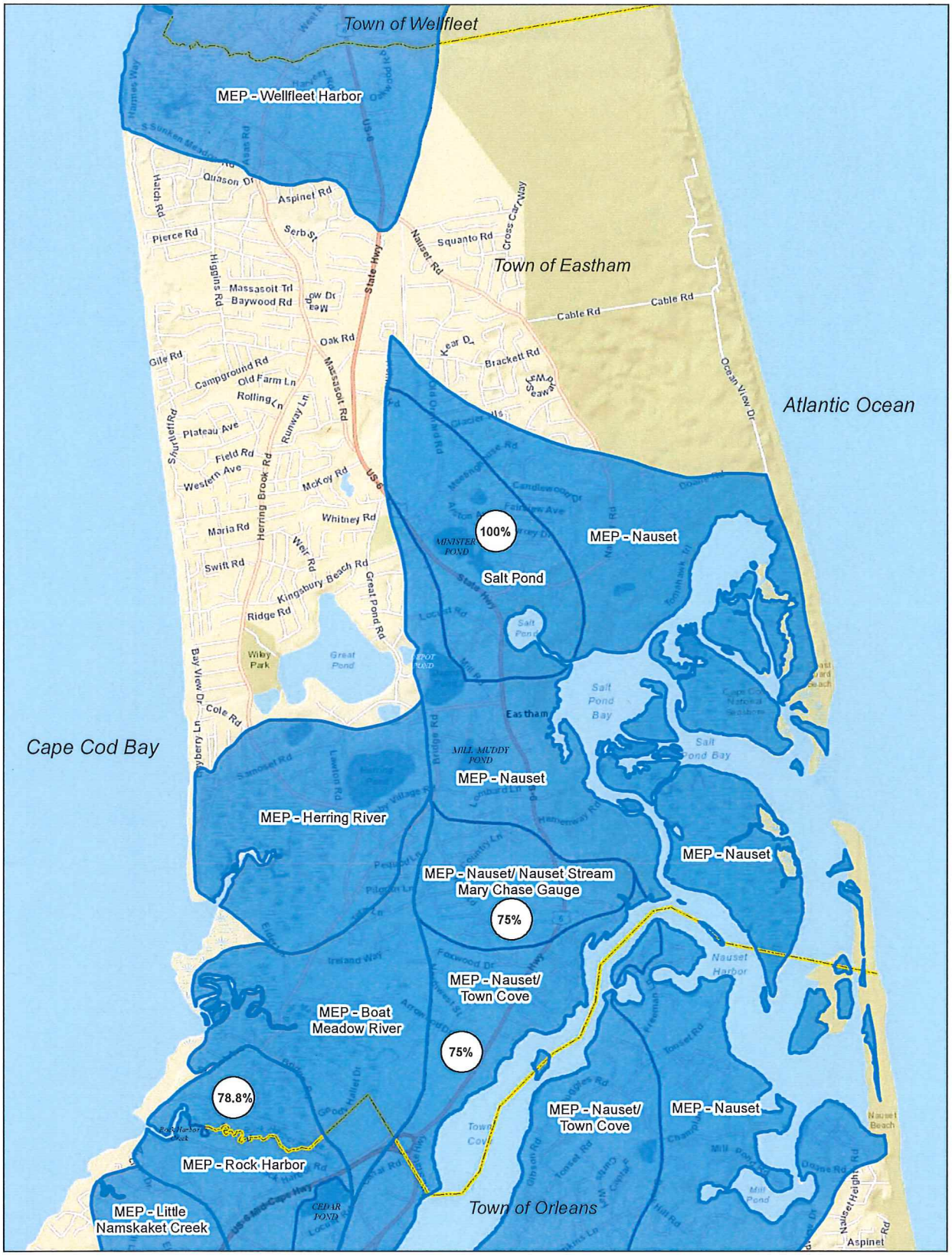

LEGEND

Town Line

Watershed Delineation

79% Wastewater Nitrogen Removal Percentage Suggested by MEP

Note 1.
Massachusetts Estuaries Project Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Thresholds for Nauset Harbor Embayment System, Towns of Orleans and Eastham, Massachusetts, Revised Draft Report - May 2012

Massachusetts Estuaries Project Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Threshhold for the Rock Harbor Embayement System Orleans, Massachusetts, Final Report - December 2008

Town of Eastham, Massachusetts
Technical Memorandum #1

Updated Watershed Boundaries with Removal Percentages

Job Number 86-18665
Revision A
Date 23 Dec 2015

Figure 2

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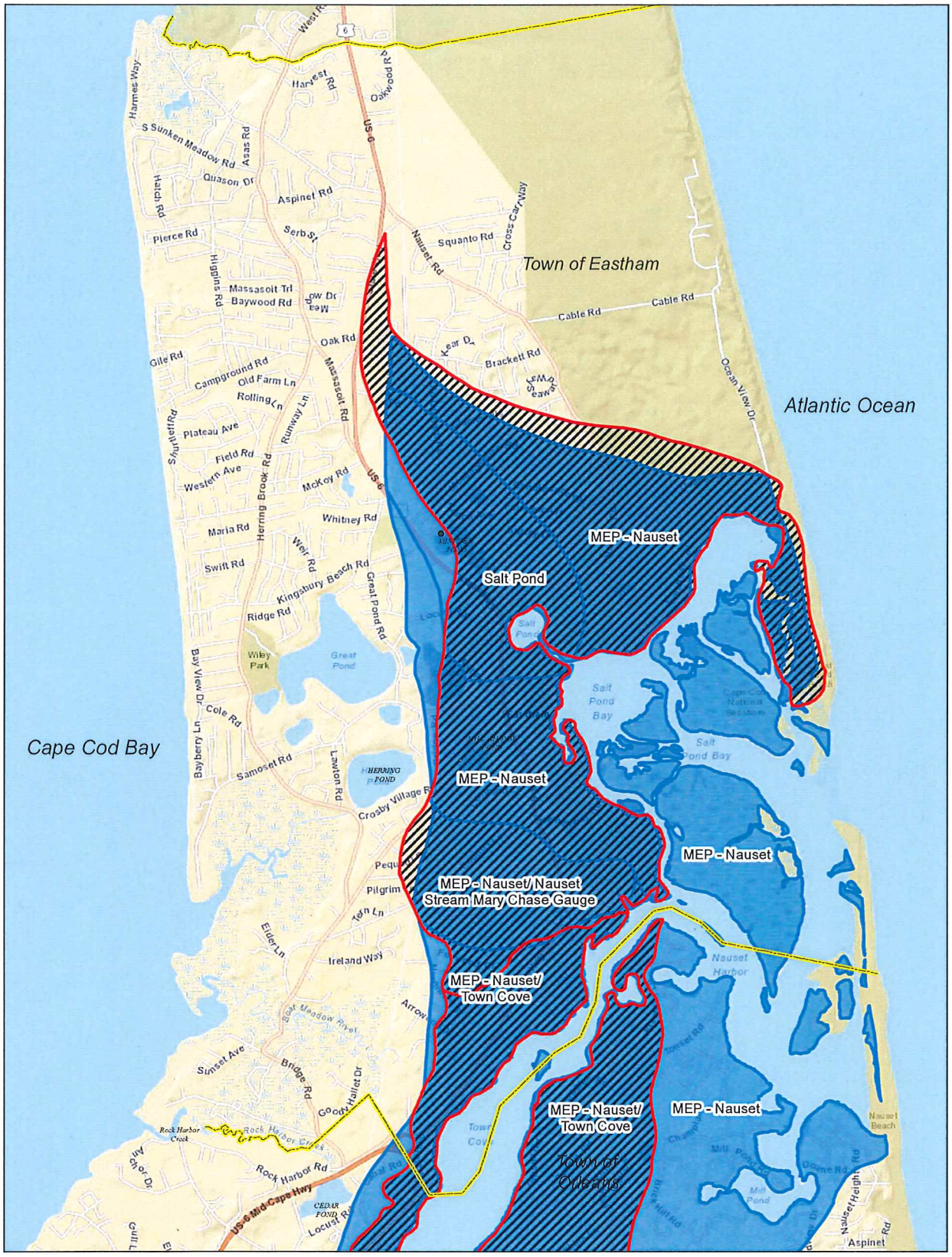

LEGEND

- 2009 Watershed Delineation - Nauset Harbor
- MEP Watershed Delineation - Nauset Harbor
- Town Line

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Map Projection: Lambert Conformal Conic
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Town of Eastham, Massachusetts
Technical Memorandum #1

Nauset Harbor Watershed Delineation Comparison - 2009 vs Current (2015)

Job Number 86-188665
Revision A
Date 23 Dec 2015

Figure 3

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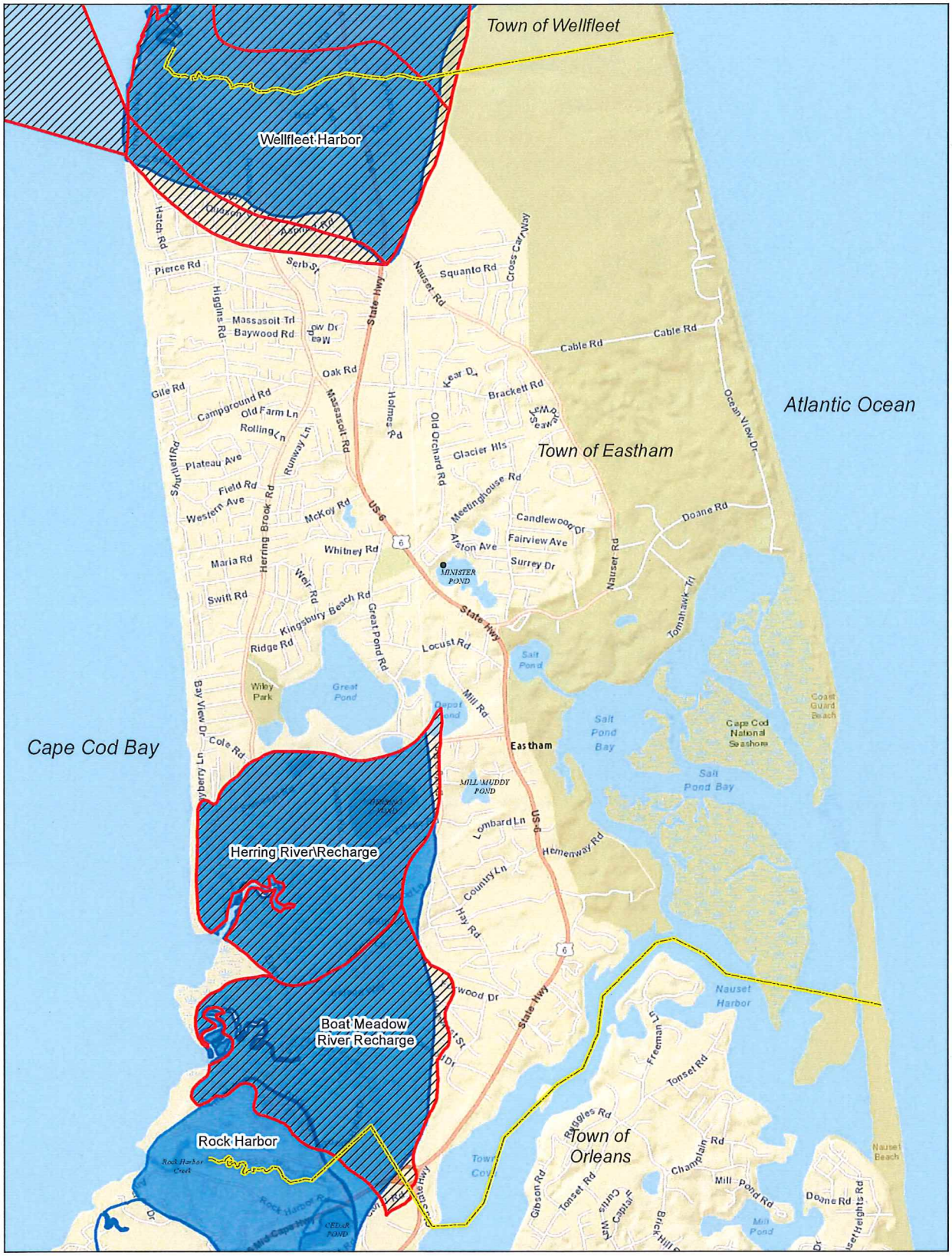

LEGEND

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

- 2009 Watershed Delineation for Herring River, Boat Meadow, Wellfleet Harbor & Rock Harbor
- Updated Watershed Boundary for Herring River, Boat Meadow, Wellfleet Harbor & Rock Harbor
- Town Line

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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GHD

Town of Eastham, Massachusetts
Technical Memorandum #1

Wellfleet Harbor,Herring River, Boat Meadow & Rock Harbor Watershed Delineation Comparison - 2009 vs Current (2015)

Job Number 86-188665
Revision A
Date 23 Dec 2015

Figure 4

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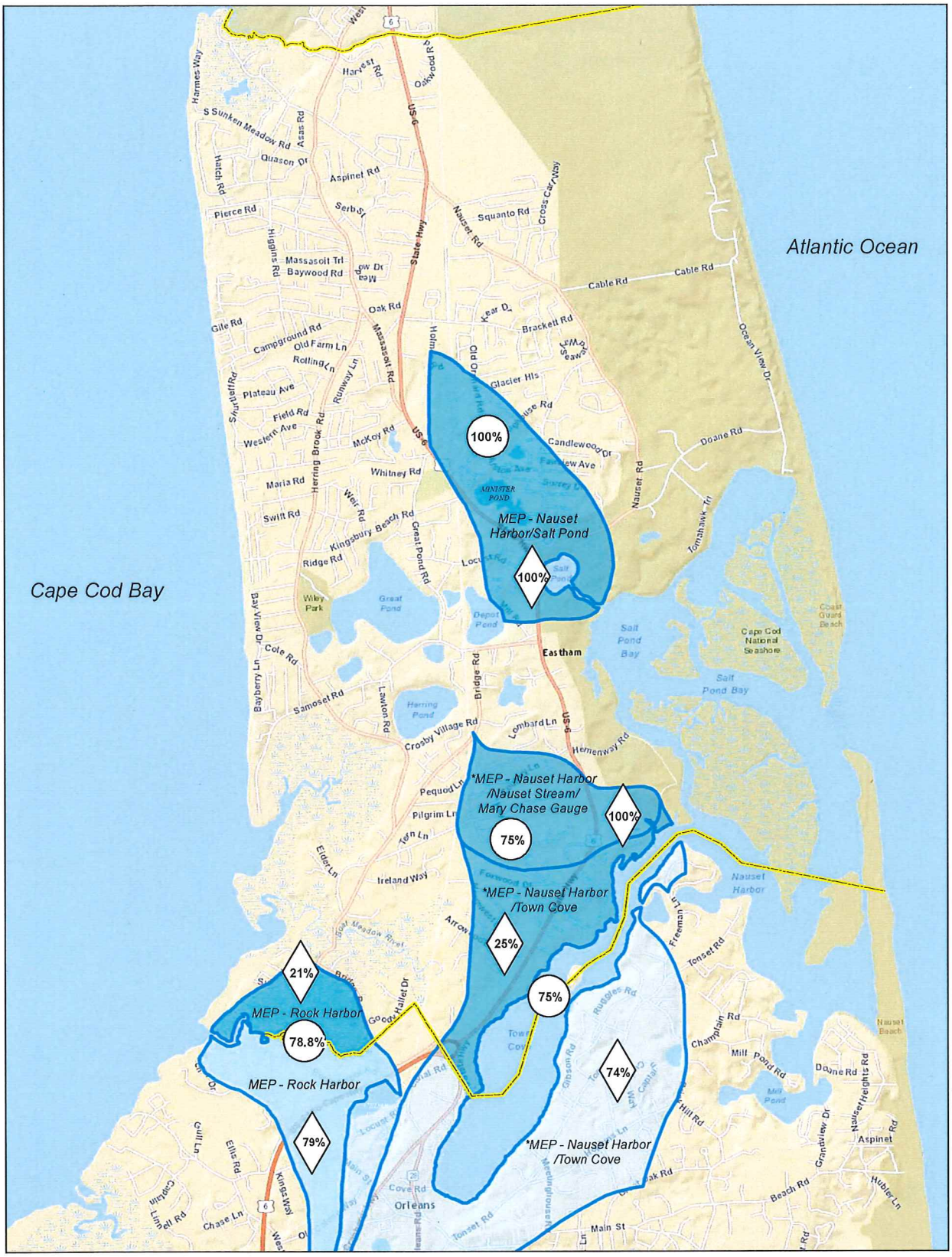

Legend

- Town of Eastham Watershed
- Town of Orleans Watershed
- Town Line
- 74% — Estimated Percent Responsibility of Controllable Attenuated Load by Town**
- 24% — Estimated Wastewater Nitrogen Removal %

*Note: 1% of the Nauset Harbor/Town Cove Nitrogen Removal Responsibility is Associated with the Town of Brewster as Estimated in the Cape Cod Commisiion 208 Plan, Appendix 8C

** Note: Based on Cape Cod Commissions Estimate in Appendix 8C of 208 Plan

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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GHD

Town of Eastham, Massachusetts
Technical Memorandum #1

Job Number 86-18665
Revision 0
Date 09 Feb 2016

ESTIMATED NITROGEN REMOVAL PERCENTAGES AND PERCENT RESPONSIBILTY

Figure 5

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Appendix A

(Summary Newsletter of Previous Planning Only)

Town of

EASTHAM, MA

Wastewater Management Planning Project

EASTHAM MOVES FORWARD WITH WASTEWATER PLANNING

At the May 2008 Town Meeting, a detailed study to address the wastewater issues facing Eastham was approved and funded. This study was designed to focus on the following key questions

Should drinking water quality problems be addressed by treating wastewater or providing public water from a protected source?
How can the nitrogen loads to the Nauset/Town Cove and Rock Harbor Estuaries be reduced as specified by the Massachusetts DEP?
How can the water quality of the ponds be improved?

Efforts by the Town's consultant, Stearns & Wheler-GHD, to address these issues culminated in the Final Report entitled "Wastewater Plan Evaluation Report" dated May 2009 which is available at Town Hall and the Town's website: www.eastham-ma.gov.

The main findings and recommendations of that report are summarized in this newsletter.

Water and Wastewater Issues in Eastham

Two key factors summarize the Town's wastewater challenges:

1. Human Health Needs. Nearly all of the properties in Town are served by individual water supply wells and individual septic systems on the same lot. These private wells are becoming impacted by septic tank effluent and other land use activities (car washing, automotive storage, fertilizer application, pesticide use, etc.). The contamination is indicated by elevated nitrate levels detected in the wells. The nitrate levels that we are seeing in Eastham are not (by themselves) a serious human health threat to most of the population; but these levels do indicate the high probability that there is other contamination (viruses, volatile organic compounds, pharmaceuticals, phosphorus, etc.) in the drinking water. The probability that these contaminants are present in private wells does pose a potential health risk.

2. Environmental Health Needs. The groundwater system with its elevated nitrogen and phosphorus levels recharges into several coastal estuaries and freshwater ponds. The nitrogen acts as a fertilizer (nutrient) in the estuaries, as does phosphorus in the ponds. This "over fertilization" stimulates the growth of algae which, in turn, causes several water quality problems in these surface waters such as: loss of water clarity, excessive algal growth, loss of animal habitat and production of odors. State, Federal, and regional agencies are now setting nutrient limits (Total Maximum Daily Loads, also called TMDLs) on the amounts of nitrogen and phosphorus that are allowed to enter estuaries or ponds.

The watersheds of the Town's main surface waters are shown in Figure 1. Septic system discharges into the watersheds are the main sources of nitrogen and phosphorus to these water bodies. Evaluations indicate that the restoration and management of long-term water quality will require the removal of 55 percent of the current wastewater nitrogen discharges from the Nauset/Town Cove Estuary Watershed; 79 percent of such discharges from the Rock Harbor Estuary Watershed; and 100 percent of the current wastewater phosphorus discharges from the Freshwater Pond System Watershed. These are big reductions.

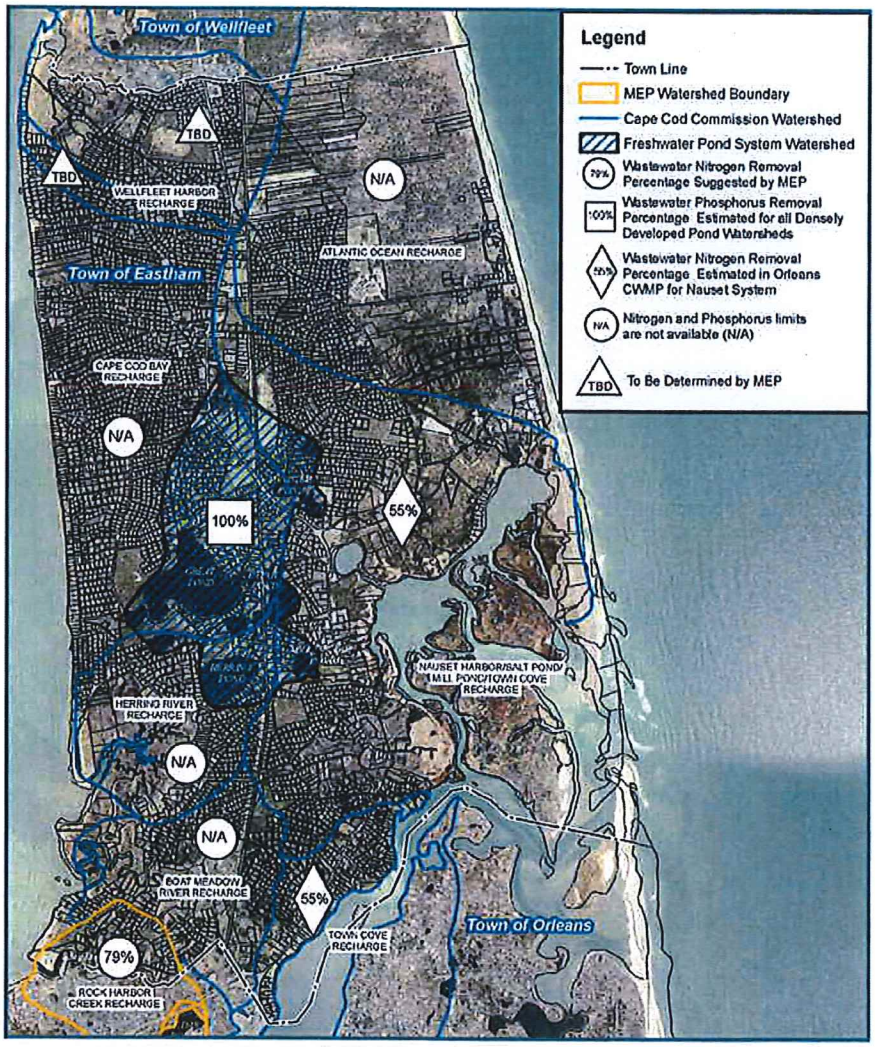

Figure 1. Watershed delineations and estimated wastewater nutrient reductions needed to address expected TMDLs.

Alternative Solutions Evaluated

All feasible technologies and management concepts were considered as possible ways to address the human health and environmental health needs, including: composting toilets, improved septic systems, community/cluster wastewater systems, alum treatment of the ponds, and individual treatment of private water supply wells. This work was completed in March 2009 and the evaluations were summarized in the Interim Needs Assessment and Alternatives Screening Analysis Report (also available at Town Hall and on the Town's website). These evaluations then selected the most feasible alternative solutions and formulated the group of Alternative Management Plans that were subsequently evaluated in the Plan Evaluation Report.

Alternative Solutions Evaluated (cont).

To address the Human Health Needs, the Town is currently evaluating the drinking water supply potential of two sources – new wells located in Eastham and the existing water system of the Town of Orleans. To ensure that the public's human health needs are met, drinking water has to be provided from a protected supply source. Time and cost factors indicate that wastewater treatment by itself is inadequate to address the human health concerns. It would take 30 to 50 years to see the beneficial effect of wastewater treatment on the well water quality; and the cost for a town-wide sewer and treatment system is estimated to be 4 to 5 times higher than that of Public Water Supply from a protected source.

To address the Environmental Health Needs, three alternative wastewater management plans were evaluated for each of the three watersheds. Considered were: 1) individual septic systems for nitrogen removal, 2) community/cluster wastewater systems for selected portions of the watershed, and 3) a more centralized sewer system leading to one wastewater treatment plant serving the selected portions of the watersheds. The study evaluated several possible wastewater treatment sites and revealed the Tri-Town septage Facility in Orleans to be the most suitable location. The study determined a joint sewer system with the Town of Orleans is the best option for the Nauset/Town Cove Estuary Watershed and, possibly, for the Rock Harbor Watershed. (Additional nitrogen work is still needed for Rock Harbor.) Alum treatment of the ponds is the lowest cost and most effective way to address phosphorous loadings to the ponds.

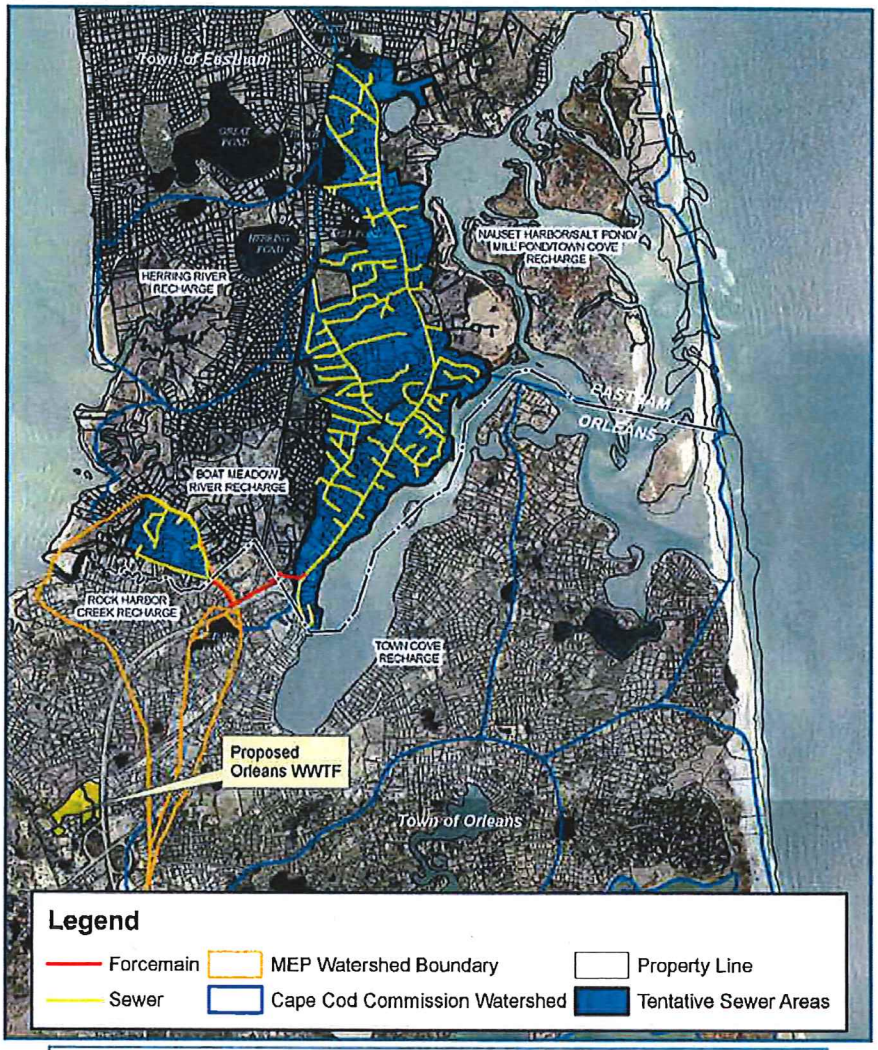

Figure 2. Tentative sewer areas needed to address expected nitrogen TMDLs.

Cost Estimates For the Plans

An important conclusion of this planning project is that Town-wide wastewater treatment is not needed. The Town's environmental health needs can be met by partial sewering of selected watersheds.

The Public Water Supply System for the whole Town is estimated to have a capital cost of $80 million.

Costs for a Wastewater Management System to address the environmental health needs are as follows.

- The sewer installations for the portions of the Nauset/ Town Cove Estuary and Rock Harbor Estuary Watersheds (see Figure 2) have an estimated capital cost of $60 million.

- If all the ponds in the freshwater pond system watershed were to be treated at one time, the cost would be approximately $1 million. But this type of treatment is typically applied over a long period of time, and some of the ponds may not need extensive management.

- Annual costs to individual property owners will need to be estimated once funding and cost distribution decisions have been developed by the Town.

- Typically, the capital costs for these systems are not paid solely by the properties in the watersheds or their sewered sections, but are shared by the whole Town.

Recommended Next Steps

The Town is proceeding quickly with the **Drinking Water** Supply planning and implementation activities because the human health need is so clear. There is more time to plan and budget for the recommended approaches to meet the environmental health needs.

Based on the main findings of this planning project, the following next steps are recommended to address the human health and environmental health wastewater needs.

- Continue to coordinate with the Town of Orleans as they complete their Wastewater Regionalization Study.

- Continue to coordinate with MassDEP as they finalize the nitrogen limits for Nauset/Town Cove Estuary and Rock Harbor Estuary, and determine their willingness to consider alternative methods to meet the limit for Rock Harbor.

Town of Eastham Comprehensive Wastewater Management Planning Project
Health Department
2500 State Highway
Eastham, MA 02642-2544

Appendix B

Stantec

CONCEPTUAL APPROACH TO MEET ORLEANS WATER QUALITY GOALS

TOWN OF ORLEANS
MASSACHUSETTS

MARCH, 2015

N

0 600 1,200 2,400 3,600 4,800
Feet

Rock Harbor Watershed:	
Technology/Approach	Estimated Size Needed to Meet Water Quality Goals
Permeable Reactive Barriers	4,700 LF
Floating Constructed Wetlands	0.5 Acres
Shellfish Aquaculture	0
Coastal Habitat Restoration/Reefs	0
Collection and Treatment	80 lots/40,000 GPD

Nauset Harbor Watershed:	
Technology/Approach	Estimated Size Needed to Meet Water Quality Goals
Permeable Reactive Barriers	2,200 LF
Floating Constructed Wetlands	1.5 Acres
Shellfish Aquaculture	2.5 Acres
Coastal Habitat Restoration/Reefs	3 Acres
Collection and Treatment	200 lots/40,000 GPD

Pleasant Bay Watershed:	
Technology/Approach	Estimated Size Needed to Meet Water Quality Goals
Permeable Reactive Barriers	1,900 LF
Floating Constructed Wetlands	3 Acres
Shellfish Aquaculture	1 Acre + Existing Shellfish Grants
Coastal Habitat Restoration/Reefs	8 Acres
Collection and Treatment	360 lots/50,000 GPD

Rock Harbor
Little Namskaket
Namskaket
Cedar Pond
Town Cove
Mill Pond
178 Beach Road
223 Beach Road
15
16
Existing Tri-Town Site
Potential Downtown Treatment Site
9 West Road
5
6
7
Clover Leaf Route 6A
29 Baker's Pond Road
Meetinghouse Pond
Uncle Harvey's Pond
Crystal Lake
Upper River
Pochet
Lonies Pond
Baker's Pond
Pilgrim Lake
Lower River
Namequoit River
Arey's Pond
Linnell Pond
Twinings Pond
Sarah's Pond
Shoal Pond
Meadow Pond
Deep Pond
Quanset
LITTLE PLEASANT BAY
PLEASANT BAY
CHATHAM

Notes
1. 25% Nitrogen reduction from fertilizer management is applied to all watersheds.
2. All non-sewered area septage to be hauled and treated at the new facility to be located at existing Tri-Town site.
3. Sludge from decentralized treatment systems to be hauled and treated at the new facility to be located at existing Tri-Town site.
4. Wastewater flows based on current parcel water usage.
5. Locations and actual size will be determined based on demonstration project results and other investigations.

Legend
- Landfill
- Downtown Sewered Area
- Meetinghouse Sewered Area

Potential Disposal/Treatment Sites
- Site 5 - Downtown Disposal
- Site 6 - Downtown Disposal
- Site 7 - Downtown Disposal
- Site 15 - Meeting house Treatment/Disposal
- Site 16 - Meeting houset Treatment/Disposal
- Watershed Boundary
- Subwatershed Boundary

Orleans Water Quality Advisory Panel
Consensus Agreement of the OWQAP
March 11, 2015*

The Orleans Water Quality Advisory Panel, or OWQAP, was convened to guide studies and assessments, define preferred approaches, seek consensus and build widespread community support for a customized, affordable water quality management plan for the Town of Orleans. The panel consists of **stakeholder representatives** (Orleans Selectmen and representatives of engaged citizen constituencies), and **liaisons** from key town boards and commissions, organizations, neighboring towns, and regional, state, and federal partners. It is staffed and assisted by Water Resources Associates, Stantec and its consultants, and the Consensus Building Institute (CBI).

The OWQAP has met for twelve half-day meetings since July 2014, all of which were open to public attendance and comment. After examining a broad range of options, the Panel has reached agreement on a set of principles and some key elements of an Amended Water Quality Management Plan (the Plan) and associated Adaptive Management Plan[1]. This Agreement includes and requires successful completion of the steps described here to resolve uncertainties and confirm key elements, such as treatment and disposal site suitability and availability, development of demonstration sites for non-traditional (NT) technologies, and further work to find an equitable distribution of costs necessary to the development of an acceptable and executable engineering plan that adheres to the key elements.

Agreed Goals and Objectives:

1) The Plan seeks to improve water quality in Orleans' natural water systems, meet nitrogen reduction targets and other key requirements of local, regional, State and Federal regulators, including finalized and preliminary TMDLs, while supporting updating of the analysis of current water quality conditions and MEP model runs. The Plan includes flexibility within an adaptive management framework to allow changes in the implementation plan to respond to any new findings from these updated analyses and resolution of other uncertainties.

2) In addition to needed nitrogen reduction, the Plan seeks to control phosphorous impacts on freshwater systems, address sanitary requirements, and respond to commercial and residential wastewater needs. The Plan also seeks to restore natural ecosystem services[2] using in-situ NT water quality solutions that offer rapid restoration, improve water and sediment quality, and restore habitat health.

3) The Plan also seeks affordability and fairness in its distribution of costs, by developing a detailed Financial Plan for allocations of costs, as well as a commitment to working together to identify and pursue all sources of grants and other financial support.

Agreed Plan Approach and Key Elements:

4) Given the potential benefits of NT technologies for removing nitrogen and phosphorous and providing valuable ecosystem services with more rapid results and at lower cost than traditional collection systems, the intent of the Plan is to maximize the use of Coastal Habitat Restoration[3](CHR), Aquaculture[4], Floating Constructed Wetlands[5](FCW), Permeable Reactive

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[1] This Plan will amend the approved CWMP approved by the Cape Cod Commission and MassDEP in 2011.

[2] Natural symbiotic processes conducted by one species and benefitting other(s).

[3] Creating habitats including shellfish reefs (such as the oyster reefs created in Wellfleet) that restore natural ecosystem services in the water body. The shellfish remove nitrogen from the water, and a bio-diverse ecosystem of many other species also contribute to nitrogen reduction. The reefs support young fish, crabs and other bottom dwelling animals, and sustain or restore the submerged aquatic vegetation (SAV) and benthic conditions necessary for natural habitat functions.

Barriers[6] (PRBs) and other approaches (e.g., inlet management) as strategies for meeting water quality goals. While there are risks and much to learn about these technologies, the *Conceptual Approach to Meet Orleans Water Quality Goals Map* estimates technologies and sizes within each watershed that could reasonably be implemented to help meet TMDLs and water quality needs. If fully successful, this could include realizing up to two-thirds of the Town's nitrogen reduction using NT technologies. A first phase of work to further evaluate the effectiveness, costs, risks, and opportunities for these NTs will be to select, design, and implement a series of demonstration projects. The findings from demonstration projects will be used to determine locations and areal extents of NT solutions, as well as their expected costs and contributions to nitrogen and phosphorous removal goals.

5) The Plan reduces the sewered footprint (area of town and number of properties to be sewered) to a minimum by maximizing the use of the non-traditional technologies referenced above. The Conceptual Approach delineates two footprints within Orleans for implementation of sewers. These areas include 1) ~280 parcels encompassing Downtown Orleans (~100,000 GPD), to be treated at a new treatment plant located at the Tri-Town site and disposed at one of several prospective sites nearby (potentially also using a reclaimed water system), and 2) ~360 parcels within the Meetinghouse Pond sub-watershed (~50,000 GPD), to be treated at a satellite treatment facility and disposal area to be identified. These areas were designated for wastewater collection and treatment because their nitrogen reduction requirements and wastewater needs could not be met using only NT technologies. The Downtown area includes numerous properties with aging and/or non-compliant systems and inadequate nitrogen reduction, which cannot be cost effectively retrofitted to meet current wastewater needs. Certain newer facilities may be "grandfathered" for some limited period of time. Options utilizing small cluster plants downtown were found not to have an economic advantage and the additional complexity involved in ownership, operation and maintenance of several small plants was a significant disincentive. Satellite or cluster treatment plants are valid wastewater treatment options in the appropriate circumstances and will be evaluated for other locations within Orleans.

6) In Meetinghouse Pond watershed, 100% nitrogen removal is required. Technology performance limitations and land use constraints in Meetinghouse Pond prevent deployment of sufficient NT solutions to meet those needs. The Plan includes siting a satellite treatment plant for the Meetinghouse Pond watershed.

7) The new treatment facility will be designed to treat septage from the towns currently served by the existing Tri-Town Septage Treatment Plant, as well as the wastewater from the downtown Orleans area only. Septage storage and treatment capacities will be evaluated for appropriate sizing, to avoid competition based on tipping fee / price. This will allow the town to continue to meet the septage treatment needs of the businesses and residents of Orleans and the Lower/Outer Cape, while generating net positive revenue that will lower customer rates in Orleans. Revenues from septage treatment will be allocated to those parties who contribute to the capital cost and Orleans will seek compensation for providing nitrogen treatment and disposal for flows from out-of-town customers.

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[4] Shellfish farming: the shellfish are filter feeders that remove nitrogen form the water system. The shellfish are harvested for market.

[5] Floating structures filled with plants that use nitrogen and other nutrients from the water to grow.

[6] PRBs intercept groundwater before it reaches the coastal water system and provide the necessary conditions for the conversion of nitrogen compounds to harmless nitrogen gas. The process is called denitrification.

8) The Plan includes an Adaptive Management Plan (AMP), which will provide a detailed approach to monitoring the success and efficacy of each component of the Plan and a framework and methodology for evaluating and adjusting solutions over time, with back-up technologies (including possibly additional sewering) to ensure compliance with regulatory requirements for water quality. The AMP will also provide for continued coordination with regulatory agencies to confirm compliance of the Plan with monitoring standards and water quality requirements, and continued monitoring of the financial and economic impacts of the plan on residents and businesses of Orleans. The AMP will also provide a framework for selecting, implementing and evaluating NT demonstration projects to refine initial assumptions about effectiveness, cost, and other implementation considerations. The *Conceptual Approach to Meet Orleans Water Quality Goals* will be updated and refined based on information developed through demonstration projects and other studies and analyses.

9) The Plan and AMP will seek to capitalize upon opportunities for potential management synergies and cost savings through cooperation with Orleans' neighboring towns of Eastham and Brewster.

OWQAP Commitment:

10) By agreeing to these principles and key features of an Amended Water Quality Management Plan, OWQAP Stakeholder Representatives endorse the goals, objectives, approach, and key elements as described above, and commit to support Warrant Articles, By-laws, and other Town measures to pursue and implement the Plan and its underlying principles. Representatives also agree to inform and engage their full stakeholder groups and related constituencies about these components and principles.

11) OWQAP Stakeholders also agree to work to refine and implement Adaptive Management in a manner consistent with these principles and with the Plan, and to work collaboratively to address challenges encountered in the process of resolving uncertainties in the Plan and to work collaboratively to finalize an executable engineering plan that is consistent with the principles of the Plan.

CONSENSUS of the Orleans Water Quality Advisory Panel is defined in their approved Operating Protocols as unanimous concurrence of the Stakeholder Representatives, representing their constituencies. Members may also "abstain." Abstaining means not offering consent or endorsement, but also not blocking an agreement. Abstaining members are not counted in determining if consensus has been reached.

Sims McGrath, Orleans Selectman
Alan McClennen, Orleans Selectman
David Dunford, Orleans Selectman
Jon Fuller, Orleans Selectman (in absentia)
Judith Bruce, on behalf of the Former CWMP Committee
Dale Fuller, on behalf of the Orleans Taxpayers Association
Jim McCauley, on behalf of the Orleans Pond Coalition
Sid Snow, on behalf of the Orleans Chamber of Commerce
Jeff Eagles, on behalf of the Orleans Water Alliance
Doug Fromm, on behalf of Orleans CAN
Peter Haig, on behalf of the Orleans Community Partnership
Abstention by Mark Fiegel, on behalf of the Citizens Peer Review Committee